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ABSTRACT

Using a heuristic system design is the most cost effective means for confronting unstructured policy problems that require action in cases in which there is a limited empirical data base or a diversity of opinion concerning preferred ends and feasible means. This paper discusses heuristic principles that can serve as guides to problem solving and explains how application of the principles reduces errors in the conceptualization of problems. The use of heuristic system design as a means of confronting ambiguity and indeterminacy in educational programming is addressed, and the value of heuristics for contemplating future policy directions is explored. The heuristic basis of processes for monitoring educational programs is noted. (PGD)

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Heuristics in an Educational System Design

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Abstract

Heuristic system designs can be viewed as an innovative perspective to the study of educational programs that are expected to confront emerging, new or "wicked" problems. Hseuristic thinking is a creative, intellectual and intuitive activity that generates new insights and directions through a design engineered to pursue a variety of searches and discoveries for "ideal types and ideal constructs" to closely approximate social reality. The purpose of this essay is to promulgate the basic principles intrinsic to heuristic thinking as they specifically apply to the critical sequences to educational program planning. Highly developed system tools and methods are introduced and placed in juxtaposition to a heuristic system design. This disclosed a human creative rational model for educational programming.

Heuristics in an Educational System Design

I. Introduction

It is the thesis of this essay that a heuristic system design is the most propitious model for educational programs where problems in development are unexpected; where changes are ubiquitous and impacts on a program's internal and external environment; and finally, where existing mainstream social research methods are deemed inappropriate.

Heuristic thinking is most viable in a search for a conceptualization and in a discovery for specifications that are necessary for structuring original problems; for example, where action must respond to an unrealized educational need, value or opportunity. A heuristic conception is primarily concerned with prospective events that will emerge and where there exists no data base of any accepted significance to confront an unmet need. Heuristic principles are therefore primarily derived from a concept of emergence: events that are "becoming." Heuristic speculations serve as guides to actions in the face of ambiguity and indeterminacy where there exists no viable model (i.e., scientific methods) or analytical solutions.[1] Heuristic thinking, therefore, within systems design context, is a creative synthesis process that engineers an educational program into action.

A heuristic conception perceives programming as a process in development: how it ought to evolve through system engineering; its methods, tools and techniques. The concept of emergence (i.e., oughts in deontic logic or anticipated normative values) when merged with the rationality of logical analysis results in a heuristic system design predicated to human creative rational action. Heuristic models are primarily concerned with precipitating action, even if this means fabricating "working expedients." An axiom to

heuristic thinking is that an educational program and its participants (students and teachers) will do a lot of learning and problem solving in development in which changes will continuously take place to produce a more efficient system. The underlying principle is that a system design can acquire the internal referents intrinsic to a heuristic conception to behave purposefully in goal directed behavior even within the realm of uncertainty.[2]

My task is to determine the viability of a heuristic system design to programming in education where action must be taken in the face of limited, restricted or omitted information. The following critical sequences to programming in development have been selected for analysis. These sequences will characterize the conditions that govern the value of heuristics: (1) Heuristic principles that generate creative working expedients in the structuring of policy problems for educational systems; (2) A heuristic search for choices in normative values necessary for forecasting program alternatives; (3) Heuristic system synthesis and analysis in recommending program and project actions; (4) Heuristic methods for monitoring program outcomes; (5) Heuristic inventiveness in evaluating educational program outputs. The intent is to demonstrate how heuristic principles reduce the realm of uncertainty and ambiguity in a process that continuously searches for the "best solution" to an original problem that it is known, from the onset, will be restructured in development.[3]

II. Formulating Educational Policy Problems

A heuristic system is particularly suited for "wicked problems" (i.e., unstructured) in that preferred ends (i.e., desirable solutions in educational policies) and alternative means (i.e., feasibilities in educational programs)

are both unknown or in disagreement. It is therefore not possible to conceptualize (i.e. causal explanations) an "unrealized felt educational need" (i.e., problematic situation) into a substantive problem. Yet, this is a necessary first step before it is possible to convert a substantive problem (i.e. through a process of specification in mathematical models) into a formal problem made subject to solution. Heuristic thinking in problem formulation process involves a creative search for a workable expedient (i.e., concepts and specificities) of a "felt" educational need. This is in contrast to well structured, moderate, and ill structured problems where either the ends can be readily conceptualized and/or the means specified.

It can be said that the structuring of all problems involving social phenomena requires some form of heuristics. Heuristics thinking is imbued with intuitive, "a priori" and tacit knowledge. Hence, dimensions of qualitative normative value choices are always intrinsic to "structuring" educational policy problems. The number of alternative approximations of the educational reality is unbounded so as to generate different solutions for a given problem as there are definitions of that problem (i.e., multiplicity of values and a diversity of interest). Heuristic thinking is intrinsically qualitative subject to alternative interpretations of reality. It becomes inventive in the engineering of an educational system through that perceived reality.

Problems in programming are perceived as interdependent (i.e., problems for designing programs in remedial reading are related to problems in other areas of learning in the curriculum); or may be perceived as subjective based on the administrators' problem conceptualization and specification or as artificial in value judgments made by those in authority to the desirability of confronting a problem.[4] Using heuristics, therefore, is an affirmation that structuring policy problems is a critical sequence to model building.

Models of a program design (i.e., how an educational policy problem is organized . . .) symbolically represents a replica of reality through "a priori" articulations and speculations.

Heuristics can be viewed as creative thinking in sequential decisions for program planning necessary in taking action and arriving at solutions. In the case of "structuring," the actualization of heuristic thinking can be expressed in nominal group techniques where the dynamics of small group interacting processes elicit an aggregate of judgments by generating a synthesis of creative and rational decisions in the face of unstructured problems. Synectics is another small group process that searches for structure through generating responses to novel situations by infusing different analogies from other sources and disciplines. Morphological analysis generates a number of element combinations to alternatives to a problem for further examination (i.e., description and explanation).[5]

Heuristic principles can be explicated as follows:

(1) "A priori" articulations coupled with heuristic speculations generate ideas necessary to design a simple but very manageable model (i.e., symbolic representations of reality) with a highly imaginative use of partial information of the actual complex educational reality.

(2) A simple view of reality enables educators to initiate a course of action with the realization that in development new insights and directions will change the original problem as well as the configuration of the social design.

Heuristic models begin as the search for ingenious ideas on simple conceptions of "structuring." As noted, as a change phenomena, it is expected that a system design will undergo elaboration in its purpose and design in

development. Secondly, a heuristic system design takes ambiguity and indeterminancy as givens in the real world of educational planning and programming. These principles are critical to a heuristic conception. An educational system design is viewed as an open, flexible and highly discretionary selection process that should serve to guard against the pitfalls of errors of the first, second and third kind. This design avoids the pitfall of choosing the wrong conceptualization of the problem situation when those responsible for problem formulation should have chosen the right one. For example, errors of the first kind can be avoided by considering alternative interpretations and conflicting conceptions of the policy problem. Classical system designs (i.e., scientific method) are irreversible cause and effect analysis and are not designed to take self-corrective actions in restructuring problems in process. Classical models have their greatest value to educational programs where policy problems are well-structured.

In the second instance, the main risk is in choosing the wrong specification of the substantive problem. Errors of the second kind are due to failure in realizing that the design boundaries and ends of all educational policy are in states of flux, dynamic and turbulent. In either case, administrators and small group educators can commit errors of the third kind: a wrong formal presentation of the problem (i.e., solving the wrong problem).[6] This leads to a third critical principle of heuristics. The problem solving capability of an educational system design increases dramatically from a simple confrontation of a problem to a higher level of problem solving complexity. This is all predicated on the belief that a system learns in development increasing its participants' problem solving capability making it possible to respond to greater challenges and increase demands. Errors of the first, second and third kind are highly improbable in heuristic system designs because problems,

principally in innovative, experimental, educational programming, continuously skirted with ambiguity and indeterminacy, are never truly solved but must be redesigned to confront unexpected change and emerging conditions to its internal design and to the external social environment that it serves.

III. Alternative Educational Programming

A heuristic system design initiates the proceedings for a program with full realization that the educational problem, value, need or opportunity will change in development and take on a different configuration in development. This conception allows for the formulation of guidelines in forcasting program alternatives--a potential course of action that can contribute towards the mitigation of a problem while simultaneously generating movement towards the attainment of an unrealized educational objective. Intrinsic to heuristic thinking is that information must be generated about alternatives that cannot be completely derived from the past or existing situation. It is taken as axiomatic that to solicit information only from the educational experiences that precipitated the problem, though essential, is not necessarily usable to forecast alternatives. It must be reshaped, recorded, and reorganized to meet contemporary conditions with an eye on changing the future state. Hence, to produce usable information on potential alternative educational programs requires choices in normative values, about the past and existing conditions expressed through conjectures about future actions. Conjectures are educational choices in normative value commitments and as such are different from prediction and projection forecasting methods that are exclusively reliant upon statistical data derived from past or mathematical analysis of existing data. Heuristic thinking takes advantage of the opportunity to merge the

subjective/creative with the objective/rational as the most parsimonous means to take action.

The selection of desired goals and objectives, follows structuring policy problems, as the secondary function in a speculative system design for educational programming. A heuristic principle for forecasting in this stage of our system design can now be stated. Conjectures on goals and objectives will be formulated to simultaneously ensure teaching and learning performance while the system design prepares to emerge in development. This will create a purposeful goal directed educational system that is designed to provide internal referents that will guide and direct action for learning under changing conditions.

The logical structure for heuristic intellectual activity is, therefore, lodged in a hypothetico-deductive methodology.[7] Conjectures syllogized as hypothesized "ideal ends" become part of the solution in which an educational system is purposefully engineered to work backwards towards realizing its ends. Hence, heuristics enter the forecasting sequence of development through a deductive/intuitive "Leibnitzian" system of inquiry that finds its reality through empirical/experientials in a "Lockean" system of inquiry.[8]

A pitfall in the use of heuristic thinking in forecasting methods (i.e., scenarios, Delphi techniques) occurs when empirical data are abundant to provide statistical predictions on next steps for action to well structured policy problems (i.e., extrapolative, exponential smoothing forecast, regression forecasting). Or conversely, predictions and projections are used when heuristic techniques are more appropriate in that they are more imaginative, innovative and experimental. For example, extending the past into future states for educational policy and programming can be contraindicated in that past does not or should not repeat itself; that commitment to the past can

lead educational systems to self-fulfilling prophesies, or past value commitments change over time and have no contemporary relevance. Heuristics offer the opportunity to place programming on a temporal dimension of a past, present and future continuum.

A heuristic system design in a pursuit of forecasting information inevitably acquires an eclectic and pragmatic posture in accepting those educational methods and techniques that work now. For example, conjectures in intuitive forecasting uses both deductive/intuitive and inductive/empirical logical processes in one unified system for programming. This insures a syncretic construct--a "sweeping into" one temporal zone the parochial perspectives of retrospective, perspective and proscriptive analysis for formulating alternatives.

IV. Recommending Educational Project Actions

It is now established that a heuristic system design is organized to anticipate changes in a sequence of actions guided by the formulation of program alternatives that were advanced to realize an educational need. As a means of confronting ambiguity and indeterminacy of any educational program in development, information must be produced about the effects and consequences of actions derived from different program alternatives. There are two major value dimensions of choice for recommending project actions.

(1) A simple decision model in which logic and rational dimensions serve as the major basis for the maximization of the "one best alternative." A "pure" rational model can observe, measure, quantify, and validate the project benefits against cost (i.e., cost/benefit analysis, cash flow analysis). Other criteria that can be used to decide the merits of projects are net present worth, benefit/cost ratio and intrinsic rate return. Cost/effectiveness can

evaluate the degree to which various alternatives achieve given objectives.[9] Variations on the theme of "limited and bounded" rationality in decision making can be found in satisficing, disjointed incremental and mix scanning models.

(2) A complex decision model is concerned with the multiple normative values and diversity of interest, that is always involved in choosing a course of action in education. This is principally the case with educational programs that are heavily seeped in uncertainty and controversy. The diverse self-interests of constituents (i.e., PTA, labor and educational associations) are continuously exchanging information with each other in an interactive process that produces changes in values, interests and beliefs of its participants, either through adaptation, integration and even antagonism.

There are a variety of systems tools and methods to unravel the complexities in recommending project actions. Heuristic system design can account for the inherent variability of the development processes by aggregating information into statistics which summarize the variability of data. For example, the likelihood of alternative outcomes can be estimated through techniques such as subjective probability assessment. Estimations and quantifications are derived from expert judgments about the chance of specific events occurring.

Decision trees are another systems tool more appropriate for the accounting for alternative outcomes in development. Decision trees determine the expected benefit of a project action by pursuing further information regarding the consequences of decision choices in sequential development. Contingency analysis is more responsive for accounting for alternatives designed for various contingencies under continuously changing conditions. This analysis

determines actions when major changes in the problem environment are expected and where there is uncertainty about the nature of change.[10]

Heuristic systems methods are concerned with "creative synthesis" as a means to avoid the either/or pitfall of "scientism" and its emphasis on causal analysis through analytical simplification (i.e., each alternative and its set of consequences defined and identified) or taken to other extremes, altruism in functionality or final ends (i.e., multifinality). One is predicated on objective knowledge lodged in "rationality," the other on normative knowledge of "creativity." Together, recommending policy actions requires a coalescence of the quantitative and qualitative manifestations of "choosing and deciding." This is an end that can only be achieved through the intellectual activity of heuristics.

V. Monitoring Educational Outcomes

Program outcomes are an observed consequence of the actions of a project in its concrete applications. Project actions do not occur in fixed or even stable states (i.e., absence of a state of flux); nor can the consequences be known in advance; or for that matter, can all the consequences be observed (i.e., movement over time). Information about project actions must be generated through a monitoring process that engineers an interrelation between program operations (i.e., before) and their outcomes (i.e., after). Monitoring is a process by which heuristic thinking, expressed throughout the sequential development of the design, is tested against subsequent experience. Monitoring of program outcomes is a strategic process by which the design, on one hand, evolves and, on the other, provides linkages between deductive/intuitive programming to inductive/empirical generalizations (i.e., from prescriptions to descriptions; from formulation to implementation, etc.).

Monitoring of program outcomes can be a process that produces information to ascertain the degree of compliance between the stated goals and objectives and the project actions taken by administrators and their staffs responsible for their operations. Planning, programming and budgeting as well as ideals strategy are methods that emphasize goals and how well each alternative meets those goals. Significantly, there is an insidious heuristic in these methods in that evaluation is part of the program selection process in defining goals and evaluating projected outputs prior to selecting a specific educational program.[11]

This leads to monitoring in relation to outputs that produce information to determine whether resources and services (i.e., educational benefits) intended for a student body have indeed been delivered. There are enumerable methods to aid in planning project implementation; measures for evaluation and even assumptions about causal linkages (i.e., logical framework, Gantt charts, critical path methods). Social auditing is particularly designed to monitor ouputs in relation to inputs, processes and outputs. The critical factor in monitoring a system is to acquire information on the administration action decisions of implementation. It is here where educational programs, services and resources are impeded or enhanced. This occurs primarily through the license of discretionary actions.

Monitoring program outcomes has particular relevance to a heuristic design confronting unstructured policy problem. Information can be produced that is helpful in accounting for the unexpected, but anticipated, teaching and learning changes the educational program was intended to effect. Social systems accounting is a monitoring method that ascertains changes in objective and subjective educational conditions over time through the use of social indicators.[12] The critical factor in determining real world viability of

program which can be achieved through the construction of a feedback system that can instantaneously monitor information for internal (i.e., morphostasis) end external changes (i.e., morphogenesis).

It would seem that a heuristic system design could acquire in and of itself a unique distinction by monitoring other educational programs relative to its own by engaging in social experimentations as the monitoring method of certain aspects of these programs. This would place heuristic systems design in a macro deterministic, innovative and experimental position. It would have the disadvantage of making claim to all "a priori" articulations and heuristic speculations even where mainstream educational programming is most appropriate in confronting "reasonably well structured policy problems."

VI. Evaluating Heuristic System Designs

The application of monitoring methods, within the context of a heuristic system design, acquires an immediate advantage of processing new information that produces insights into the complex and multiple causes and consequences of an educational program. In contrast, evaluation produces information about the total performance of an educational system and its program's delivery earmarked to satisfy unrealized need, values and opportunities. Monitoring responds to the descriptive and explanatory (i.e., when, how and why), while evaluation asks the pragmatic question: What difference did heuristics make in the program design?

As noted earlier, a heuristic system design is activated upon the principle that change is ubiquitous; that new challenges and direction become necessary to confront these changes and hence, problems in education are not solved, but restructured. Evaluation, therefore, in a heuristic system design, is not a matter of validation but verification; is not to determine if

a problem was solved, but how did a program contribute to realizing unmet educational needs. The critical factor to evaluation is how to solicit information within the context of heuristics that can restructure the problem and develop more relevant alternatives.

Given the character, nature and quality of a heuristic system design in a sequential development, process emerges in which evaluation is perceived as a daily requirement for a program. Evaluation is a continuous process, is more useful than, let us say, retrospective analysis of periodic events and occurrences already experienced. Developmental evaluation enables the design to learn from its experiences and to adapt immediately to new experiences. This form of evaluation is responsive to internal and external feedback information processes where it is anticipated changes in performance will be necessary as the educational systems production changes the external social environment.[13]

VII. Summary

A heuristic system design was selected as the most parsimonious conception by which to confront unstructured policy problems that require action and where it is known that there is a limited empirical data base and/or where a multiplicity of values and a diversity of interest exist on preferred ends and feasible means. Heuristic principles were disclosed to serve as guides to action in providing working expedients through the various sequences to educational program development. The logical structure necessary for "sequencing" serves as system or sub-system boundaries by which heuristic thinking emerges in a "priori," intuitive and tacit knowledge. A sample of a number of

system methods and tools used in the various sequences illustrated how human creative rational actions can be implemented in a system design for educational programming.

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